Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 Level 2nd Semester Examination – January 2019
MRT 382-3 Water Treatment Methods

Uva Wellassa University

Index Number:-

Instructions
Duration: 03 hours
Number of questions: Part A – 02 (Two) and Part B – 20 (Twenty)
Answer All Questions
Mark allocation: Part A – 50 and Part B – 50
Illustrate your answers with sketches/diagrams where necessary.

Part A

1. The following note has been extracted from a proposal made by a consultant to the client on a wastewater treatment train design of a textile factory.

"The effluent treatment plant train was considered similar to the process water treatment plant based on the requirements provided by the client. Further, low sludge production, low plant footprint, zero discharge of hazardous waste, and capital cost were considered. The design capacity of the plant is 3000 m^3/d and it is expected to replicate the same design with existing infrastructure on phase basis implementation. It was estimated that the capital cost of the new effluent plant of 3000 m^3/d is Rs. 257.7 million."

a. How do you compare the basic design principles of drinking water and industrial wastewater treatment facilities? (03 marks)

b. The designer has concentrated on four main advantages of his own design based on sludge, footprint, hazardous waste and capital cost. Explain the importance of above four aspects in industrial wastewater treatment (04 marks)

c. The following effluent water quality details are presented by the client in his RFP (Request for Proposal) document to the client. Discuss about the wastewater characteristics based on the main parameters to be considered in the design process.

(04 marks)

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Table 1: Effluent Characteristics

Parameters	Water quality
Water temperature (°C)	50
pH	5 -7.5
COD (mg/l)	850 - 1300
BOD5 (mg/l)	120
Nitrogen as ammonia (NH3) (mg/l)	30 - 50
Phosphoros, Total (P) (mg/l)	1.3
Total nitrogen (TN) (mg/l)	90
Color	400
SS (mg/l)	200
Hexavalent chrome (mg/l)	<0.004
Petroleum (mg/l)	6
Anion active agent (mg/l) - surfactants	4
Sulfide (S2-) (mg/l)	2
Phenyl amines (mg/l)	2

d. Further, the effected discharge quality has been set as following as well (Table 2). Discuss about importance of achieving above standards based on the environmental sustainability. (04 marks)

Table 2: Design Specifications for Discharge Water Quality

Parameters	Water quality
COD (mg/l)	80
BOD5 (mg/l)	20
Nitrogen as ammonia (NH3) (mg/l)	10
Phosphorus, Total (P) (mg/l)	0.5
Color	40
SS (mg/l)	50
pH	6 - 9
Petroleum (mg/l)	6
Sulfide (S^{2-}) (mg/l)	0.5

e. Propose and discuss an appropriate effluent treatment train to achieve the above discharge quality referring to the given wastewater characteristics. (10 marks)

02 Wastewater treatment has been recognized as one of the most important activities in managing environmental pollution. Developed countries have already established 100 % coverage of treatment.

a. Discuss about the importance of wastewater treatment to maintain a healthy environment. (04 marks)

b. What is activated sludge process (ASP)? Explain with a simple flow diagram. (04 marks)

c. The basic design calculation of a Moving Bed Bio Reactor (MBBR) process has been given below. Complete the design calculations. (10 marks)

Basic guidelines for the MBBR design:

Reference (Table 9 – 16, pp – 955, Metcalf and Eddy)

Biofilm surface area	= 300 – 350 m^2/m^3
Organic load	= 4 – 7 kg BOD/ m^3. d
MLSS Concentration	= 2,500 – 4,500 mg/L

Client information:

Flow Data

Flow rate (Average)	= 16,000 L/day
Operational time	= 16 hr
Peak factor	= 2
Peak flow	= (16,000 /16) X 2 L/day
	= ..... L/Hour
Maximum COD recorded	= 8,000 mg/L
Average COD recorded	= 4,000 mg/L
Assume BOD/COD ratio	= 0.7

Maximum BOD to be removed in sewage = 16,000 X (8,000 X 0.7) /1000 gr

Maximum = ... gr or 90 .....kgs

Average BOD to be removed in sewage = ...

Average = ... gr or ..... kgs

Blower Design

Blower capacity required (Maximum) = 50 m^3/hour per 1 kg BOD

= .....

= ..... m^3/Hour

Tank Volume Design

Collection tank = Minimum 8-hour HRT

= .....

= L

MBBR Tank = Minimum 6 hours HRT

= .....

= L

d. Estimate the dimensions of the clarifier for the above system assuming the hydraulic retention time as 3 hrs. (04 marks)

e. Assuming excess sludge generation rate as (maximum) 0.1 kg per 1 kg BOD, calculate the total sludge production per day. (03 marks)

(Total 50 marks)

Part B

1. What is the general value of G for rapid mixer design?
2. What is the general surface loading rate design value of slow sand filters?
3. Name three basic types of water stabilization ponds?
4. What is the optimum horizontal velocity of a grit channel?
5. Explain the importance of maintaining the above velocity.
6. What is the standard filtration rate for a rapid sand filter?
7. What is the general design range for retention time (HRT) of sedimentation process?
8. What are the three steps followed in a jar test experiment in a water treatment plant laboratory?
9. What does UASB stands for?
10. What are four basic zones of a sedimentation basin?
11. What are three base materials (raw materials) for activated carbon production?
12. What are the two basic forms of activated carbon available in the market?
13. Which is the best form of activated carbon to use in temporary contamination?
14. What is the most important parameter to consider in wastewater treatment process?
15. What is the mostly considered key parameter in water treatment process design?
16. What does MLVSS stands for?
17. What are two main types of wastewater found in domestic establishments?
18. Name three water related health issues?
19. What are four main factors affecting on the efficiency of coagulation process?
20. What is the minimum retention time to be maintained in clear water reservoir?

(Total 50 marks)

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